

Towards a Flow Field Model of Language Processing
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The basic idea behind this presentation is that text can only be analysed with reference to somebody or something being its source. This means that there must be a person speaking or writing the text, some perspective by which it is produced, and a speaking or writing mechanism that transports linguistic form and organization into structural information, i.e. text. In principle, there is nothing new in this statement. What is new, however, is that these relationships of text have been operationalized in a system of analysis, named Perspective Text Analysis, in which the transport mechanism makes possible the discovery of the structural information but is naturally separated from it. Traditional language models presuppose a 1-1 relationship between organization and structure and, consequently, miss the perspective dimension.

James J. Gibson (1979) made an important statement about environmental perception. Information exists in the form of a flow and can only be perceived when the perceiver is in locomotion. This means that perception of structure is a process which comes about in the cooperation of the physical energy (force field) generated by the perceiver and the flow field formed by the environment. In this systemic cooperation between force and flow there are on the one hand laws pertaining to the physical properties of "the transport vehicle", such as size and weight (mass), constraining the energy produced, and constraints within the perceptual mechanism, widening or narrowing the quality of the information flow on the other. The principal difference between energy and flow is that an observation and analysis of flow prerequisites the existence of energy but not the reverse. The consequences of this conformity to law are expressed in the way in which the two language models are operationalized. The traditional model builds on energy constraints, the new model to be presented builds on informational constraints.

The aim here is not to outline or explain details, only to make some important points, which, hopefully, will facilitate the understanding of the differences between

the two approaches.

The Force Field Model of Language

Traditional linguistic theory is founded on the conception of language as a universal human phenomenon and that, therefore, there has to be a genetically rooted grammar consisting of universal categories by means of which phrases and sentences are formed in different languages and by which these are assigned meaning. The purpose of linguistic science is to find out which the primitives of language are and from these simple building blocks make constructions of complex and even more complex relations. Just like what concerns human biology on the whole, smaller and greater units are described in terms of hierarchically organized anatomical parts. The anatomical system is finite with respect to its constitution at the same time as it is infinite as to its reproductive ability. As a consequence, the central aim of linguists is to describe the constituents that interact to reproduce meaning.

Chomsky

The first modern grammar was a so called phrase structure grammar consisting of a set of symbols (labels) and immediate constituency rules (Chomsky, 1957). By means of a set of instructions the constituents are ordered hierarchically to derive meaning. This kind of description is often displayed in tree diagrams. The diagram of the syntactic base model, SVO, looks as in Figure 1.

Figure 1 about here

Redefined into grammatical function the NP on the higher level corresponds to the subject and the lower one to the object. However, the tree does not show any ordering step between the rules, which is a main problem.

It is the surface phenomena which make language natural to a perceiver. The classical example of a sentence

which is unnatural but correct according to phrase structure rules is 'Green ideas sleep furiously'.

A grammar shall fill the purpose of not only making possible a description of natural morphological variation, but also prevent the construction of ungrammatical sentences (according to some conception of a normal world). Chomsky (1965), therefore, introduced a set of context sensitive rules which subcategorize the main symbol, e. g. the noun:

$$N \rightarrow [+N, \pm \text{Common}]$$
$$[+\text{Common}] \rightarrow [\pm \text{Count}] , \text{ etc}$$

By this measure the lexical (semantic) specification becomes constraining and the NP concerned gets a higher weight. Similarly, the VP may be specified, for example with denotations of tense and rules as to what subjects and objects (e. g. $[+\text{Animate}]$) are grammatically correct in connection with certain verbs. In this way the syntactic structure together with its semantic constraints builds up the "language mass".

The motion of the model is symbolized by the so called transformations, which denote a set of rules operating on a deep structure by deleting, inserting, copying, and moving symbols in a prescribed order to generate a surface structure. The probably most well known and discussed optional T-rule is the passive transformation, which, applied to a symbol sequence of the type NP-Aux-V-NP interchanges the NPs, adds grammatical information to the Aux, and marks the so called agent by the preposition 'by'. Figure 2 shows an active diagram for the surface sentence 'John loves Mary' (State 1) and a passive diagram, i.e. 'Mary is loved by John' (State 2).

Figure 2 about here

From the figure it is evident that the passive construction has more weight than the active. The transformations

introduce a procedure in the description, which has been taken as cognitive evidence. But structural changes, as the transformations are thought to be, prerequisite conservations, which means that there has to be a mechanism taking care of experience. A TG-description, however, does not propose a memory. All experience is incorporated into the formalism, which evidently defines structure as 'propositional knowledge' (see also Pereira & Warren, 1980).

Fillmore

An extension of the Chomskyan grammar and an attempt to theory concerning the semantic component was presented by Fillmore (1968). The point of departure is that case is a deep structure phenomenon and that the relation between the first and second NP corresponding to the grammatical cases nominative and accusative is not enough for a conceptual description of language. So Fillmore changes the structural representation of the kernel sentence to Modality and Proposition, shown in Figure 3.

Figure 3 about here

The P-constituent is thereby extended to take verb + one or more case categories, as the following example shows:

$$v \left[NP_1, NP_2 \dots \right]$$

Among the cases supposed to be represented in the deep structure the most frequently discussed are Agentive, Instrumental, and Objective. The lexical selection rules are connected to the definition of case, for example such that a semantic feature of a noun must be [+Animate] if the noun is Agentive. The verbs determine what case frame they can take. In this sense the 'frame' is a complex symbol for type of sentence. The relation between cases and grammatical subjects and objects is here illustrated by the following example sentences from the case frame of 'open':

<i>Sentence</i>	<i>Case</i>
(a) <i>The door</i> opened	O
(b) <i>John</i> opened the door	A
(c) The door was opened <i>by John</i>	A
(d) <i>The key</i> opened the door	I
(e) John opened the door <i>with a key</i>	I
(f) John used <i>the key</i> to open the door	I

The verb 'open' takes Objective or either Agentive or Instrument or both.

The deep representation of case form is a prepositional construction. The prepositions are keys between deep and surface case and are not always manifest (compare sentence f). The preposition of A is 'by' and of I 'with', but only in combination with the semantic weights of the nouns, such that 'by' marks I if the noun is not animate. Grammaticality then is a question of the realization of the frame in a linear hierarchic order among the cases.

Fillmore's model presupposes that humans make classifications of events in the world around them and that these cases in a static way are incorporated in the linguistic mass of knowledge. Thus there are no possibility of change in the events, neither with respect to kind nor to time change. The consequence for the system is the demand for a huge memory capacity.

A Flow Field Model of Language

The central aspect of an energy model for the study of language is various ways of attributing meaning to language elements. Language is assumed to be an organism, a corpus of words, phrases, and combination rules, which a so called language user has at his disposal and from which he makes choices depending on the situation. Further, the language user becomes analyzed and assessed according to the kind of lexical specification and also to the degree of syntactic complexity in such a way that the power of his language is associated with some kind of intellectual ability. It follows that researchers talk about corpora of

language as rudimentary and incomplete, sometimes even imprecise, incorrect, and deceptive, which give rise to negative attributions.

Energy constraints are surface phenomena, bound to the transport vehicle itself, implying that they are non-directional. If, instead, we refer to Gibson's law of the information flow-field emerging as a stream in the direction towards the force field, and if we suppose that this law, since it operates like a natural law, is applicable also to the verbal flow, then we have created a new language model. This model acknowledges that language obeys biological laws, which implies that it has directionality and is as precise as other biological systems.

The highest form of a living organism's use of natural laws are voluntary motor acts. These are instantiated for example when a human being puts itself in motion and walks towards a determined point. The rhythmic movements formed during walking give rise to what we call a motion schema, which on the one hand depict properties of invariants typical of humans on the whole, but also of personal characteristics. A force field analysis of the walking mood specifies kinetic relations which necessarily comprise the properties of the mass. When analyzed as flow-field, on the contrary, it is conceived as the intentional behaviour, the personal style, which calls for the observation of interactions of kinematic kind. The same holds for language. The model to be presented has been developed for the study of language as a free, natural flow and the language act as intentional. A schematic illustration of the model is given in Figure 4.

Figure 4 about here

A basic prerequisite of the model is a directed relation between Agent (A) and Objective (O), which forms nested interactions in the irreversible flow of information. (a) stands for action. Action cannot be studied without a context, i.e. intention. The context is created by the agent

through its conduct to the objective, i.e. that which the action concerns (Bierschenk, 1978, 1989). This relationship is reflected through language and not in language. For sure, in the realization of the components the elements may coincide with linguistically determined agents and objects, but only by accident. The (AaO) model namely does not presuppose any semantics, since it is founded on directionality and that the agent therefore by the prescribed configurational order constraints itself in relation to its objective. (The grammatical concept of word order is irrelevant, since it concerns recognition of the subject.)

The action component which is represented by the linguistic element 'verb' is functionally specified. It is the mechanic prerequisite of the rhythmic movement in language which we distinguish as text. This connecting function is shown in Figure 5.

Figure 5 about here

The movement of this kind should not be confused with a Chomskyan transformation in which the elements are changing position within a sentence, comparable to a geometrical space. The language space is functional and the events are (as in a biological space) localized not only in space but especially in time. The significance of this for text analysis is that agents and objects may move in a pendular mood within the textual flow without being changed as to their linguistic aspects. However, the movements develop informational changes, since the flowing incorporates time, which is always related to context.

Perspective Text Analysis

The name of the method, Perspective Text Analysis, connects to the Gibsonian theory that information comes into existence in the flow and that the perception of it is governed by such informational constraints that are specific to a perspective. 'Perspective' is here conceived

as the individually bound component (intention), carried by and reproduced in the text through the Agent component (Bierschenk, 1989). It is plausible to assume that there is only one perspective in a naturally produced text. Therefore, the analysis must recognize and control all the agents in order not to lose control over the flow. For this reason the syntactic pattern needs to be utilized, because it functions as a manifestation of the functional presence of the components.

The base unit is the graphical sentence, which has no other characteristics than being demarcated by so called sentence markers (.?!). As a rule, it marks that a transformation has taken place, since it starts the process anew. Within a graphical sentence there may be graphical clauses, demarcated by clause markers (mostly a comma, but also so called function words: and, or, etc.). Clauses are transitions, i.e. steps on the path towards transformation.

It is a natural thing in the course of the process that especially agents, but also objects, are not manifest in the graphical pattern. In order not to lose the thread through the text and not to disturb the rhythm, the analysis supplements textual elements into their functional places in the pattern. In case of the clauses in being transition points, the agents are easily found along the path and are being copied into the empty place from the preceding clause. A sentence which starts without a manifest agent (question, imperative) is conceived differently in that its agent dummy is a reflection of the explicit perspective. There are two possible analyses of this textual dimension. One is that the individual and the agent coincide functionally such that the individual acts as agent of his own viewpoints. The other puts the outer parenthesis one more step to the left, which means that the individual is agent for a perspective of higher order, e. g. an organization or an idea. The symbol of this agent function is X. Who or what X really is cannot be discovered before the completion of the entire analysis.

Functional insertions of object elements are made on the basis of the idea that the Objective streams in the direction towards the acting force. As a consequence, this textual elements are copied from the next following clause. In an end of sentence that opens towards an unknown objective (= end of text), the unknown is represented by the symbol Y. In the following empirical example (Bierschenk & Bierschenk, 1986) the principle of agent manifestation is illustrated. Functional insertions are given within parentheses.

.	Why	(X)	should	I	()	(X)	help	the	community?
	clause	Ag	verb	Obj	clause	Ag	verb	Obj	
	marker				marker				

Because of these functional insertions it may sometimes happen that clauses seem meaningless from a semantic point of view, which is an effect of conventions in interpretation.

As has been mentioned, function words are used to mark sentence and clause boundaries. Within this frame the prepositions have the function of differentiating in the optic array to form gestalts out of the contours. The Objective distinguishes between the subcomponents Figure and Ground, which are necessary for the development of structure, Instrument, and finally Setpoint, which denotes the point at the horizon seen from the point of view of a scope of action. The Figure has no preposition marking it, while the prepositions marking Ground are the ones localizing objects in space and time. Prototypical are 'in', 'on', and 'under'. Because of the importance of the Ground in forming conceptions (Bierschenk, 1984) these are the most frequent. The prepositions of Instrument are primarily 'with' and 'by', and of Setpoint it is 'for'. Finally it will be illustrated the manner in which the agent function as governing principle cooperates with the objective function to form connections which are realistic in their specification.

The background of the example sentence is the Visual Cliff experiments (Gibson & Walk, 1960) in which infants' depth perception was tested on a virtual cliff:

The infants were lured into locomotion by their mothers

Syntactically, this sentence marks a passive transformation. Semantically, the preposition 'by' specifies the mothers as agents, since they are humans. With a functional analysis there is no need for semantics because the instrumental function of the mothers in the Visual Cliff experiments is directly picked up by the preposition 'by'. The mothers had no intention in the experimental scope of action. Thus the agent to be supplemented into this sentence is the 'unknown X', which may be Eleanor Gibson and Donald Walk, who conducted the main experiments, or James Gibson himself, or the idea about ecological perception.

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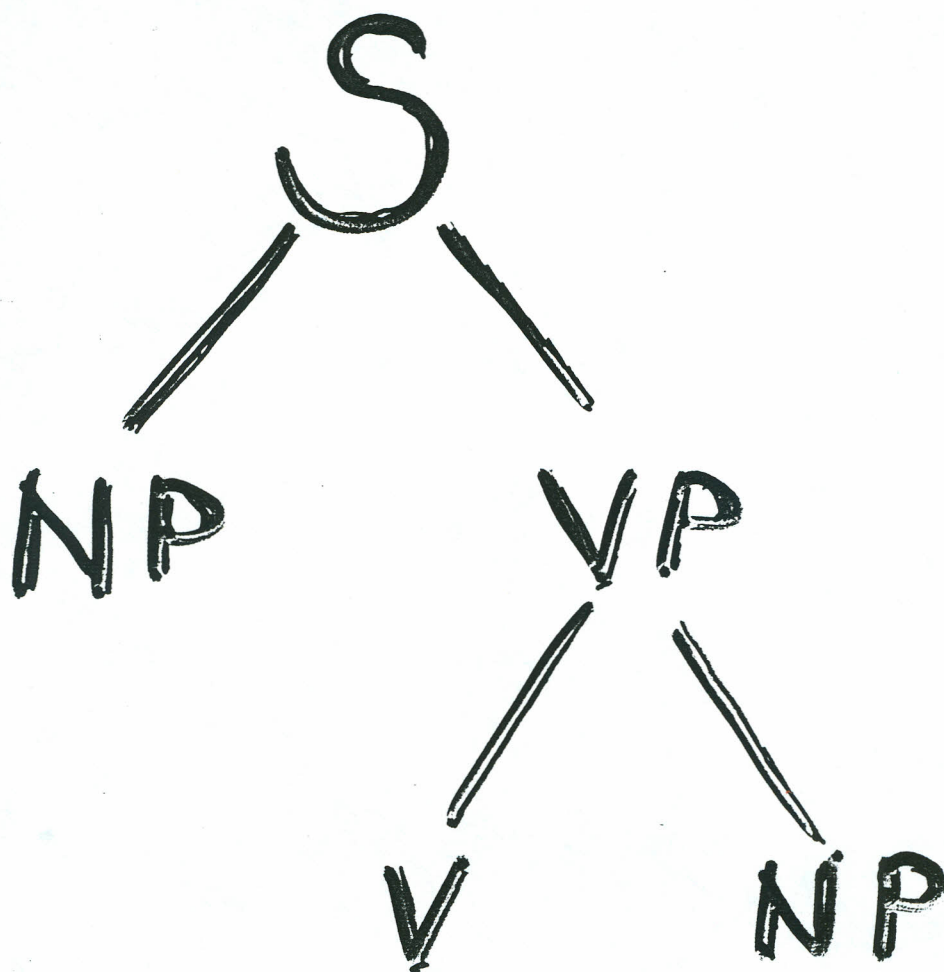
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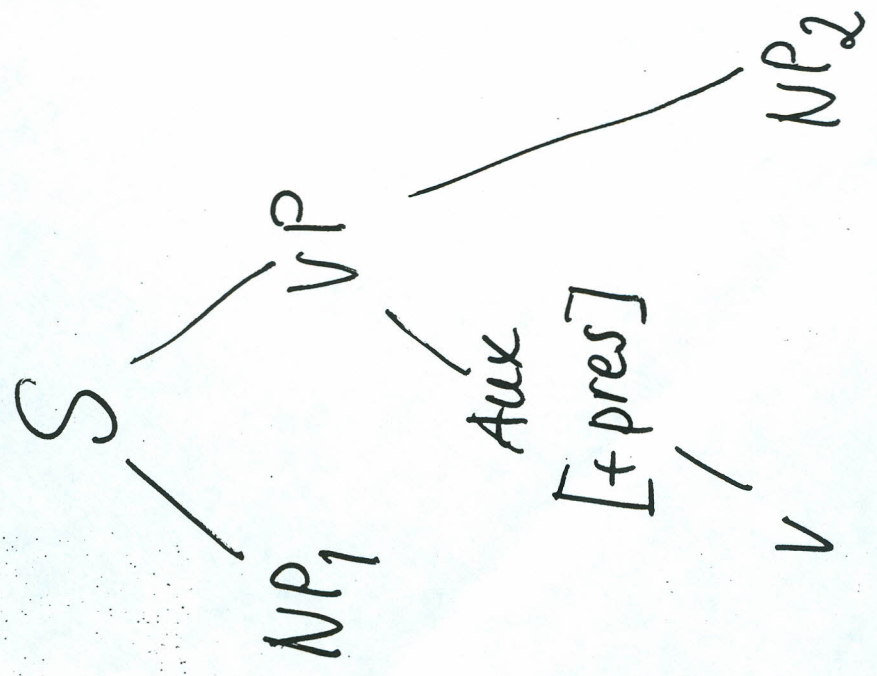
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Fig. 1

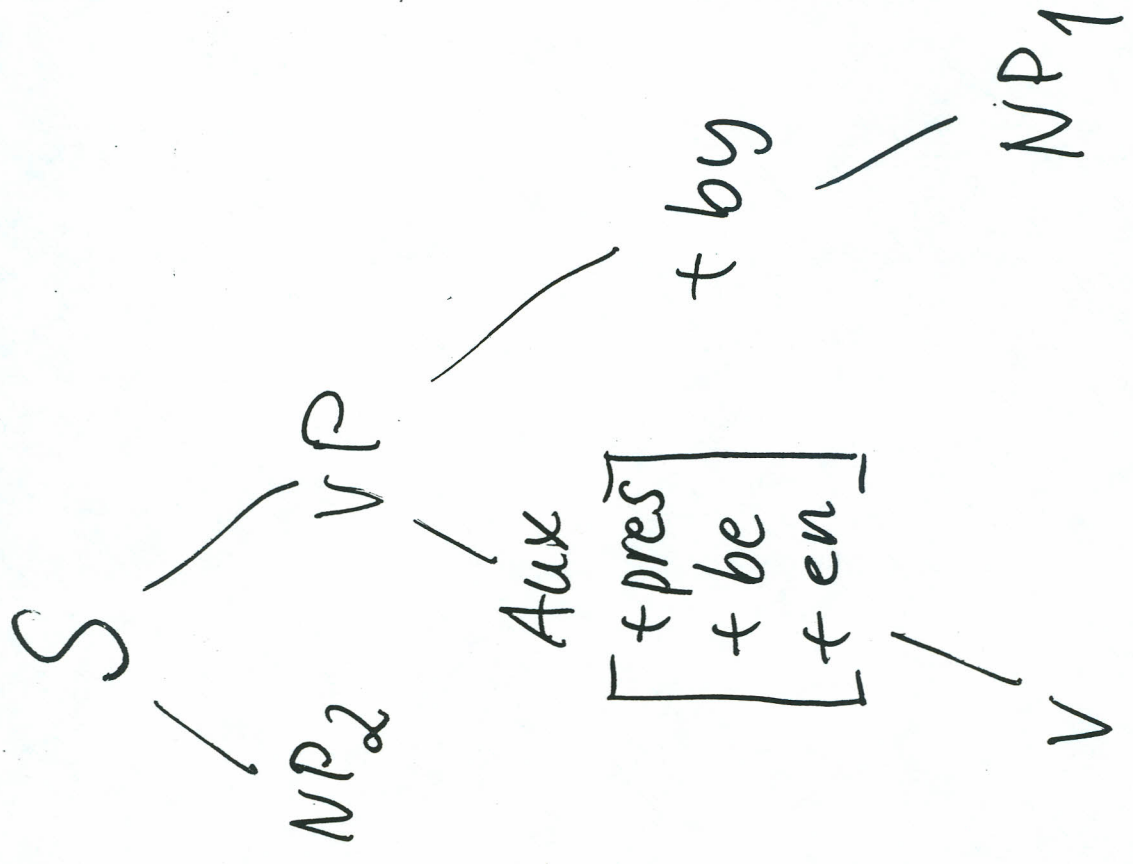


State 1



John loves Mary

State 2



Mary is loved by John

Fig 3
Ex 2

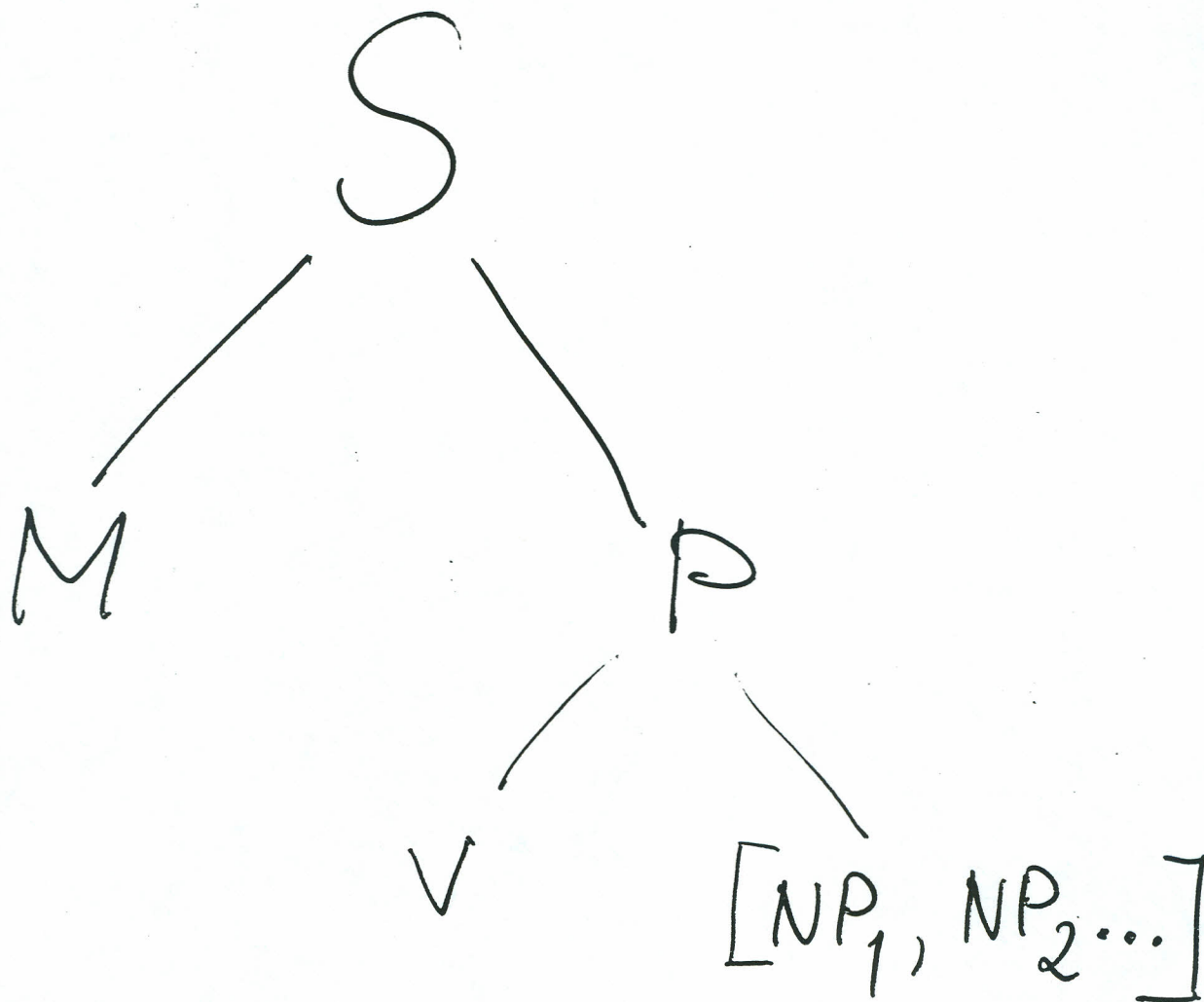




Fig 4

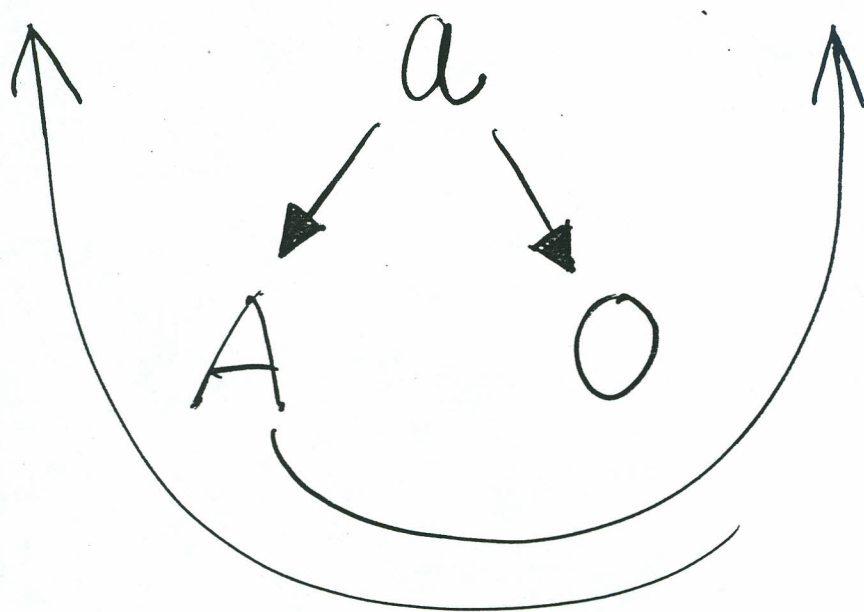


Fig 5